Global carbon emissions from deforestation reveal surprisingly stable carbon dioxide uptake by land and oceans

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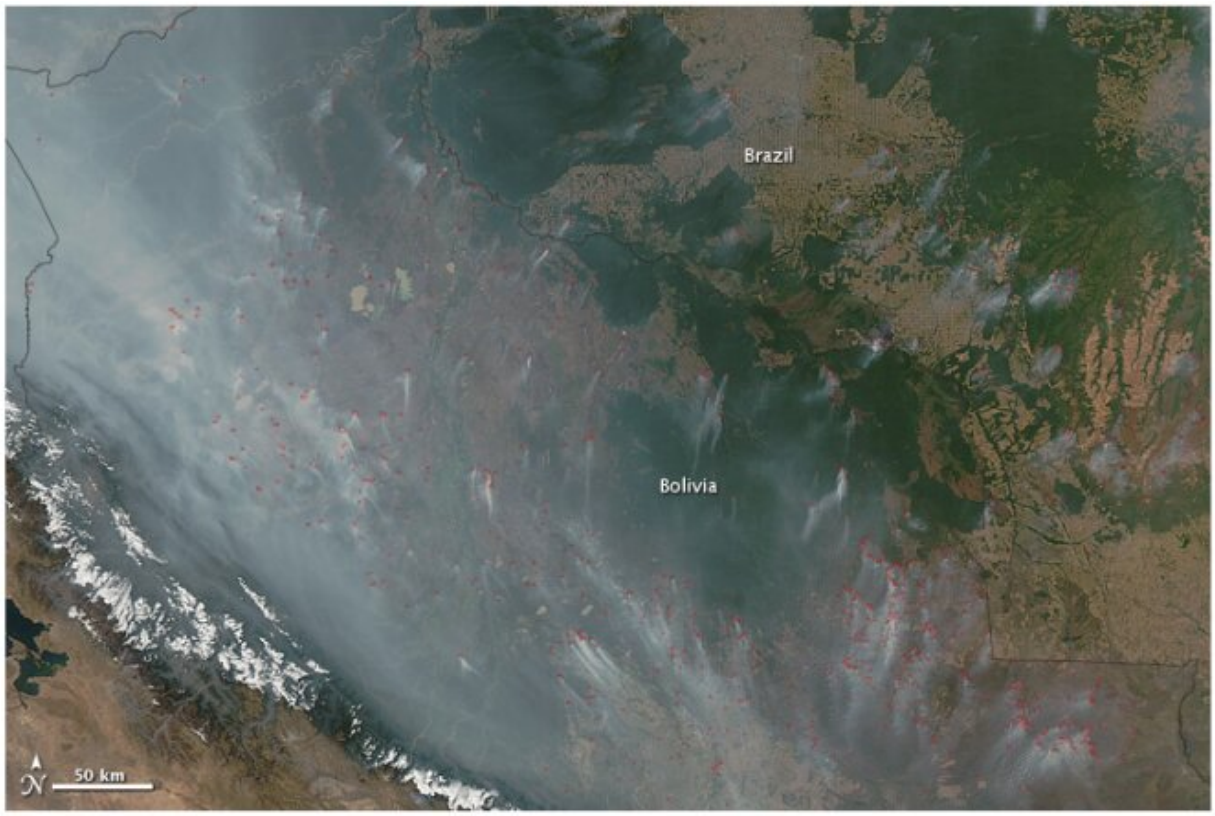

Smoke from forest fires in Bolivia and Brazil, as observed by the MODIS satellite during the 2010 fire season. Credit: NASA / Jeff Schmaltz

Researchers have constructed a new time series for global carbon

emissions from deforestation. The series is the missing link in terms of the improved understanding of the global carbon cycle, and it implies that the natural uptake of CO_2 by the land and oceans is more efficient than previously assumed.

The study shows that carbon emissions from deforestation between the 1960s and 1980s were lower than previous studies had assumed. By combining the time series with other datasets, the scientists show that the uptake of CO_2 by nature is so far influenced less by climate change than was thought in the past. The new study was conducted by scientists from Deltares, VU University Amsterdam, Woodwell Climate Research Center, Columbia University, and Wageningen University and Research and published 16 March in the scientific journal *Nature*.

Time series reconstruction

To estimate the carbon emissions in the principal deforestation areas in South America and Indonesia, the scientists used records of visibility data in a surprising way. If there are large numbers of forest fires, visibility declines due to levels of smoke and these visibility data are therefore a measure of the number of forest fires linked to deforestation in these areas.

"Records of visibility at—for example—airports go back much further in time than satellite data. By linking them to deforestation and forest fires on the basis of satellite measurements for more recent periods, we were able to establish a new time series of carbon emissions from deforestation and in that way to clarify the role of deforestation in the global climate system," explains joint lead author Margreet van Marle, a climate researcher at research institute Deltares.

Visibility data are recorded by weather observers alongside more conventional observations such as temperature and precipitation. "These

records are shared in real time by weather services around the world and have fortunately been archived. We were able to use them as a proxy for fire before the modern satellite record," said Robert Field of Columbia University, who was involved with the study.

Stable carbon cycle

Since the 1970s, we have known that about half of our carbon emissions from the burning of fossil fuels and deforestation stay in the atmosphere. The other half are reabsorbed by oceans and land. Extensive research has been conducted into whether this ratio changes in the long term, possibly because climate change impairs the capacity of vegetation and oceans to absorb CO_2. This could lead to an acceleration of climate change because more CO_2 is left in the atmosphere. Previous studies provided evidence for this but they also stated that firm conclusions were difficult to draw, particularly because emissions from deforestation were uncertain and based on inconsistent data series.

The new time series shows that compared to earlier studies, emissions from deforestation were lower from the 1960s to 1980s. The scientists therefore believe that a larger fraction of the total emissions stayed in the atmosphere. Over the entire sixty-year time series, this results in a negative trend: A sign that CO_2 uptake by nature has kept pace with growing emissions from fossil fuels and may even have become more efficient over time.

According to joint lead author and VU climate researcher Dave van Wees, this negative trend is now robust but the cause remains uncertain. "It may well be that some of the climate feedback loops that we are concerned about, such as the thawing of permafrost or more forest fires, are already making their mark but are being offset by other mechanisms. More research is needed to pinpoint the roles and trends of individual mechanisms."

Implications

According to Guido van der Werf, a professor at the VU University of Amsterdam specializing in the global carbon cycle who set up the study, it is difficult for the time being to draw firm conclusions from this paper about future climate change. "What we can mainly prove is that the worst nightmare scenarios of an impaired carbon sink have not yet materialized and that the news is not quite as bad. But we cannot say that we now have more time to achieve the climate targets. That is primarily because the good news is mainly based on new insights relating to the period of the 1960s, 1970s, and 1980s. Looking at the last few decades, it might be that the improvement in efficiency has stalled."

According to Jan Verbesselt, associate professor in remote sensing at Wageningen University & Research, who was involved with the time series analysis of this study, "Follow-up research therefore focuses on early warning signals and the resilience of ecosystems such as tropical forests for the current more extreme climate, resulting in intense droughts and large forest fires."

More information: Margreet J. E. van Marle et al, New land-use-change emissions indicate a declining CO2 airborne fraction, *Nature* (2022). DOI: 10.1038/s41586-021-04376-4

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